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(58) Field of search
UK CL (Edition J) G1N NADW NAEC NAED NAFC NAFD NAFE NARA NEAA NENR
INT CL⁴ A61B

(54) Respiration sensor and monitor

(57) A sensor (1) and monitor (10) for detecting cessation of breathing. The sensor is intended for attachment to the abdominal wall of a patient, comprises two or more flexible conductive layers and a flexible dielectric layer, and is responsive to movement in the abdominal wall by altering its capacitance. Circuit means (A, B, C, D) detect those changes in capacitance having frequency and amplitude characteristics appropriate to movements associated with breathing. Alarm means (O, Q, P, U) responsive to the absence of detection of breathing movements over a predetermined period are provided to indicate cessation of breathing. The sensor described is generally circular and connected to the monitor by a coaxial cable (7). The sensor comprises outer electrodes (2*a*, 3*a*) connected to the cable sheath, and a central electrode (4) connected to the cable core. The outer electrodes are insulated by layers (2*b*, 3*b*), and the sensor also includes a compressible foamed plastics pad (5).

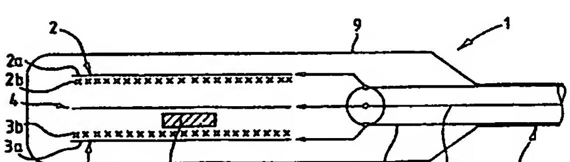

Fig.1.

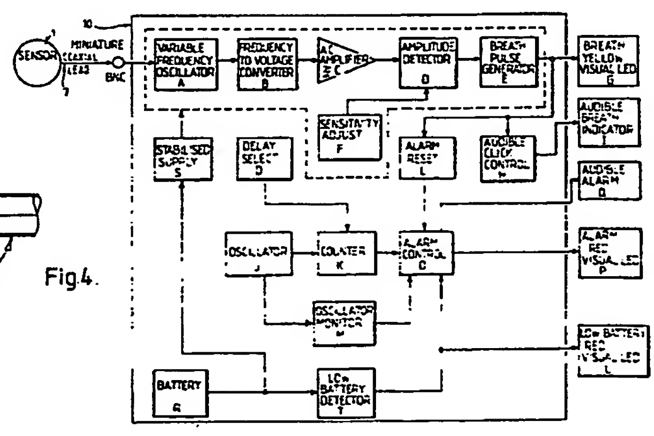

Fig.4.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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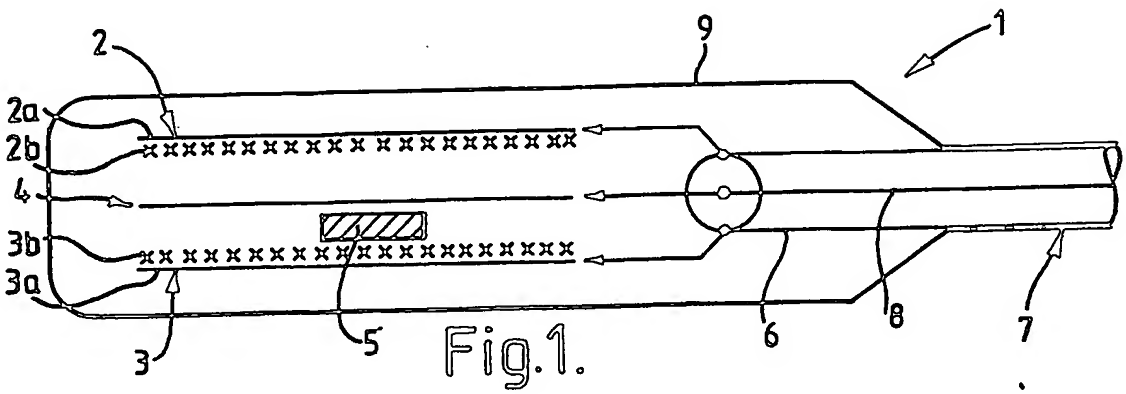


Fig.1.

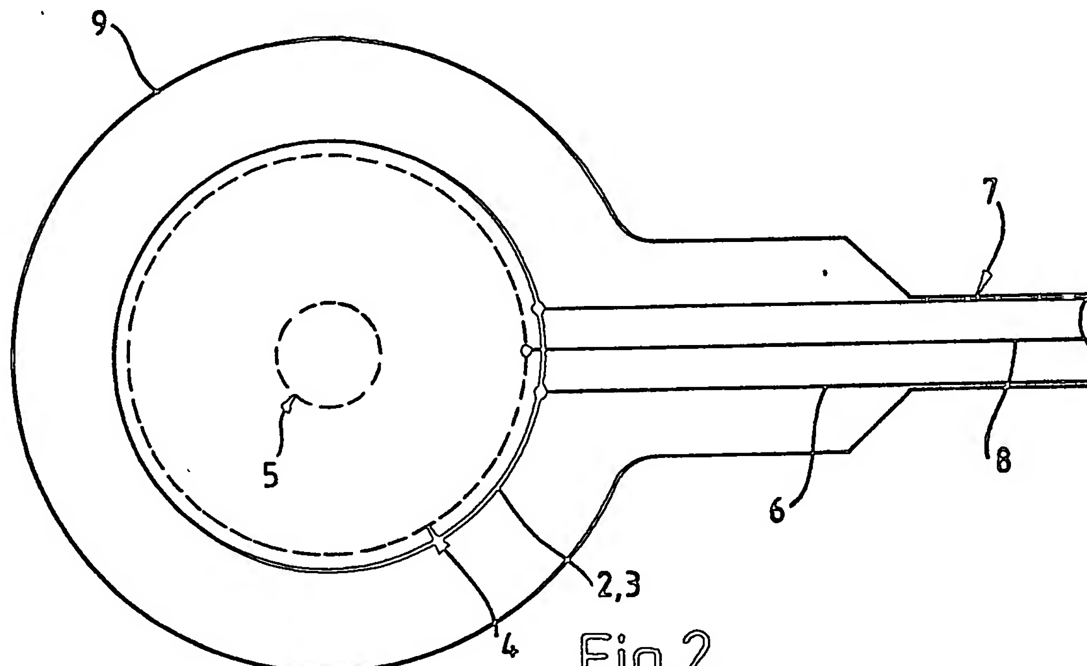


Fig.2.

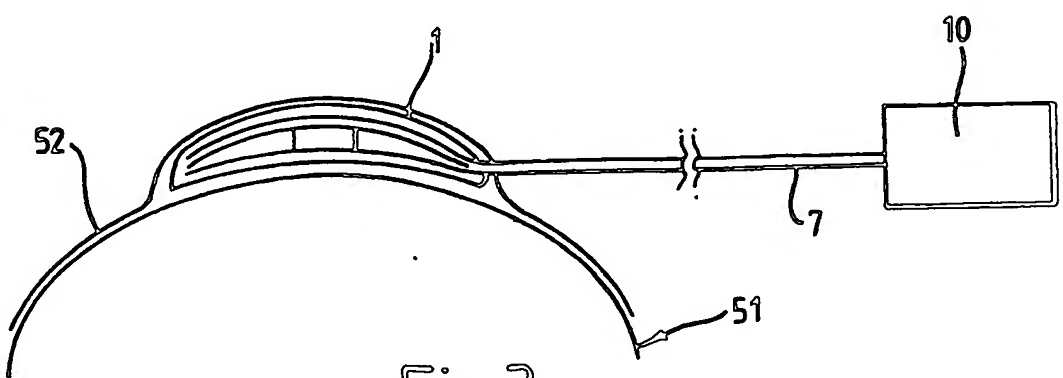


Fig.3:

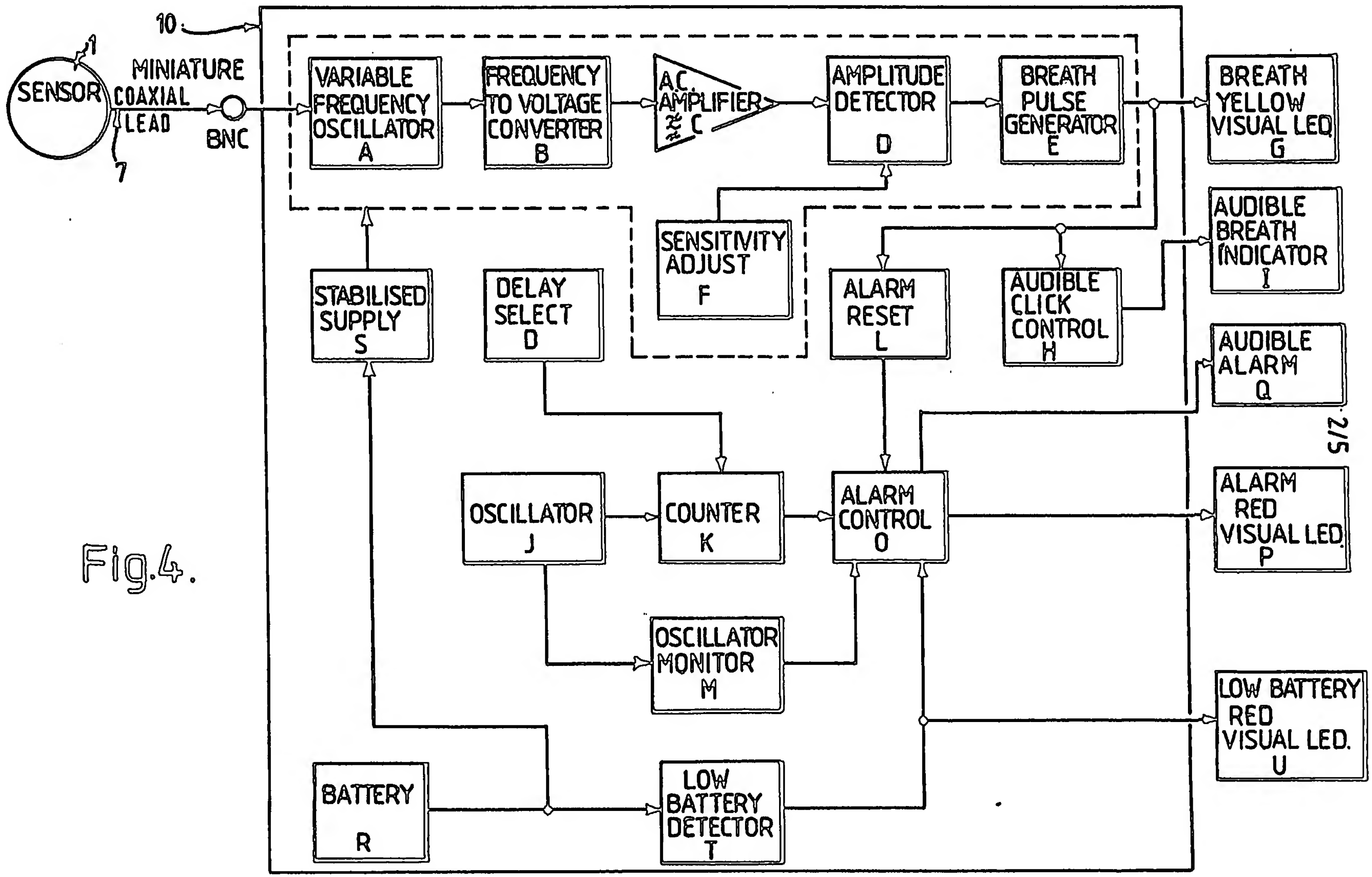
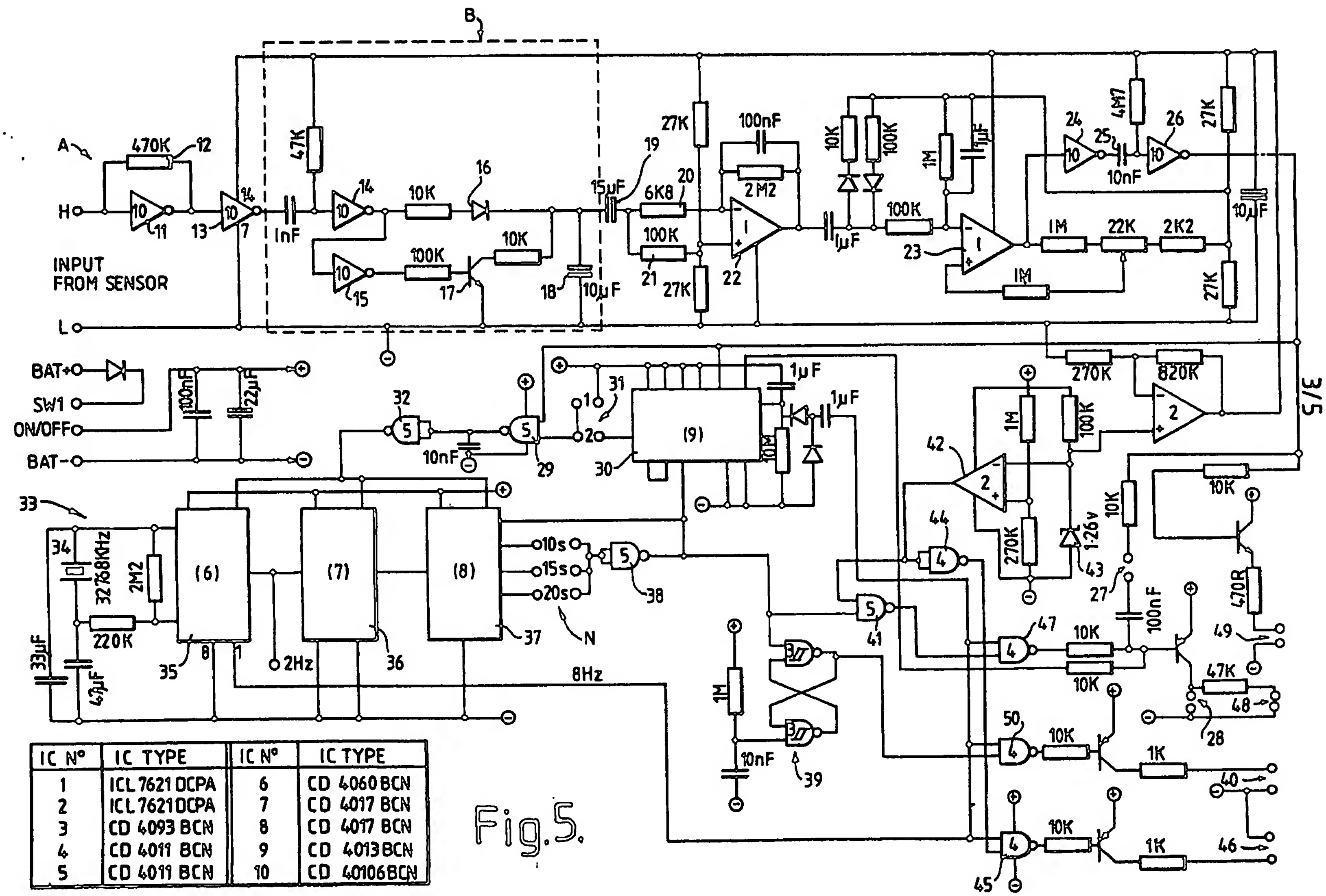
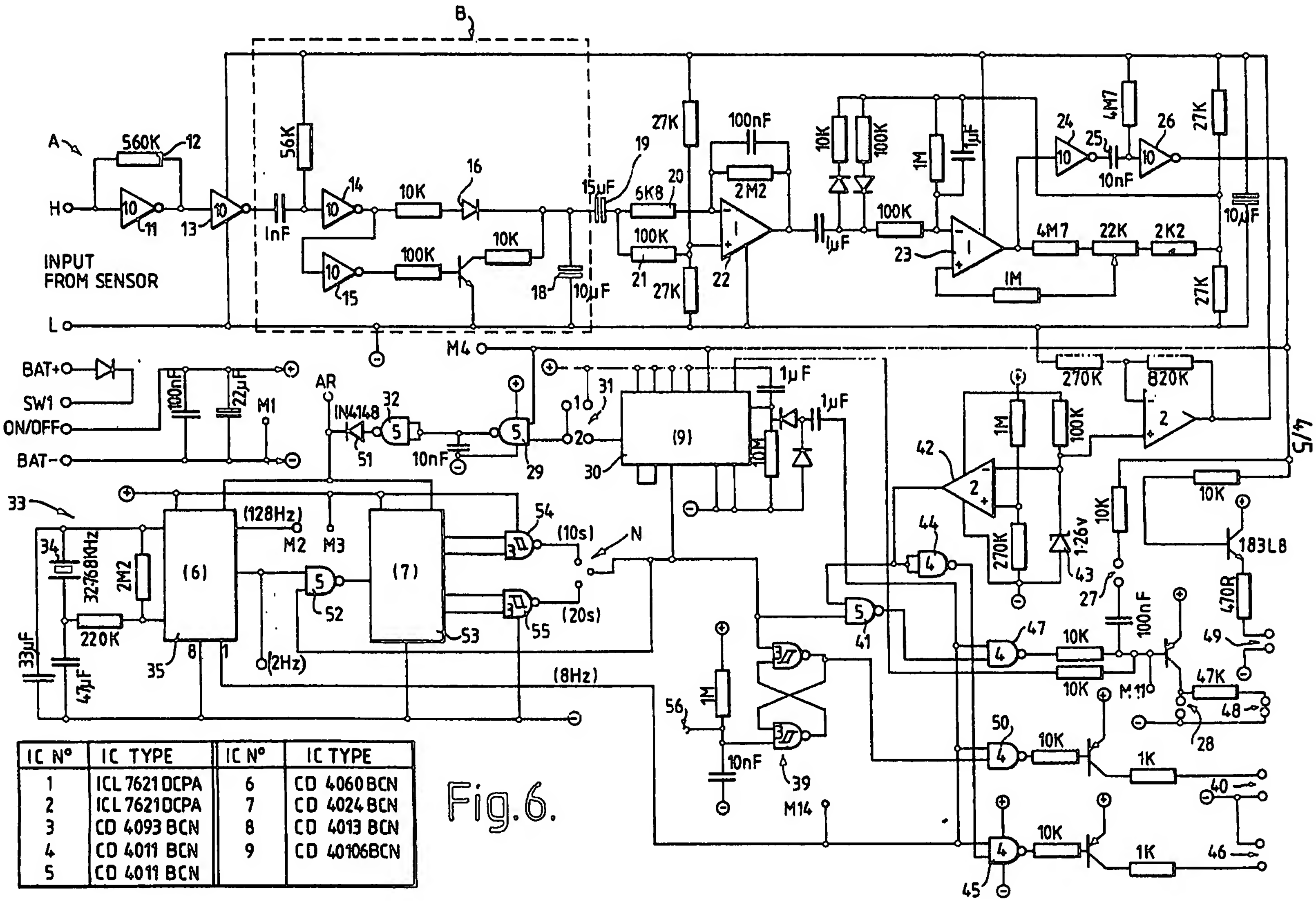

SENSOR
1
MINIATURE COAXIAL LEAD
7
BNC
10
VARIABLE FREQUENCY OSCILLATOR A
FREQUENCY TO VOLTAGE CONVERTER B
A.C. AMPLIFIER C
AMPLITUDE DETECTOR D
BREATH PULSE GENERATOR E
BREATH YELLOW VISUAL LED G
SENSITIVITY ADJUST F
AUDIBLE BREATH INDICATOR I
STABILISED SUPPLY S
DELAY SELECT D
ALARM RESET L
AUDIBLE CLICK CONTROL H
AUDIBLE ALARM Q
OSCILLATOR J
COUNTER K
ALARM CONTROL O
ALARM RED VISUAL LED P
OSCILLATOR MONITOR M
LOW BATTERY RED VISUAL LED U
BATTERY R
LOW BATTERY DETECTOR T

Fig.4.



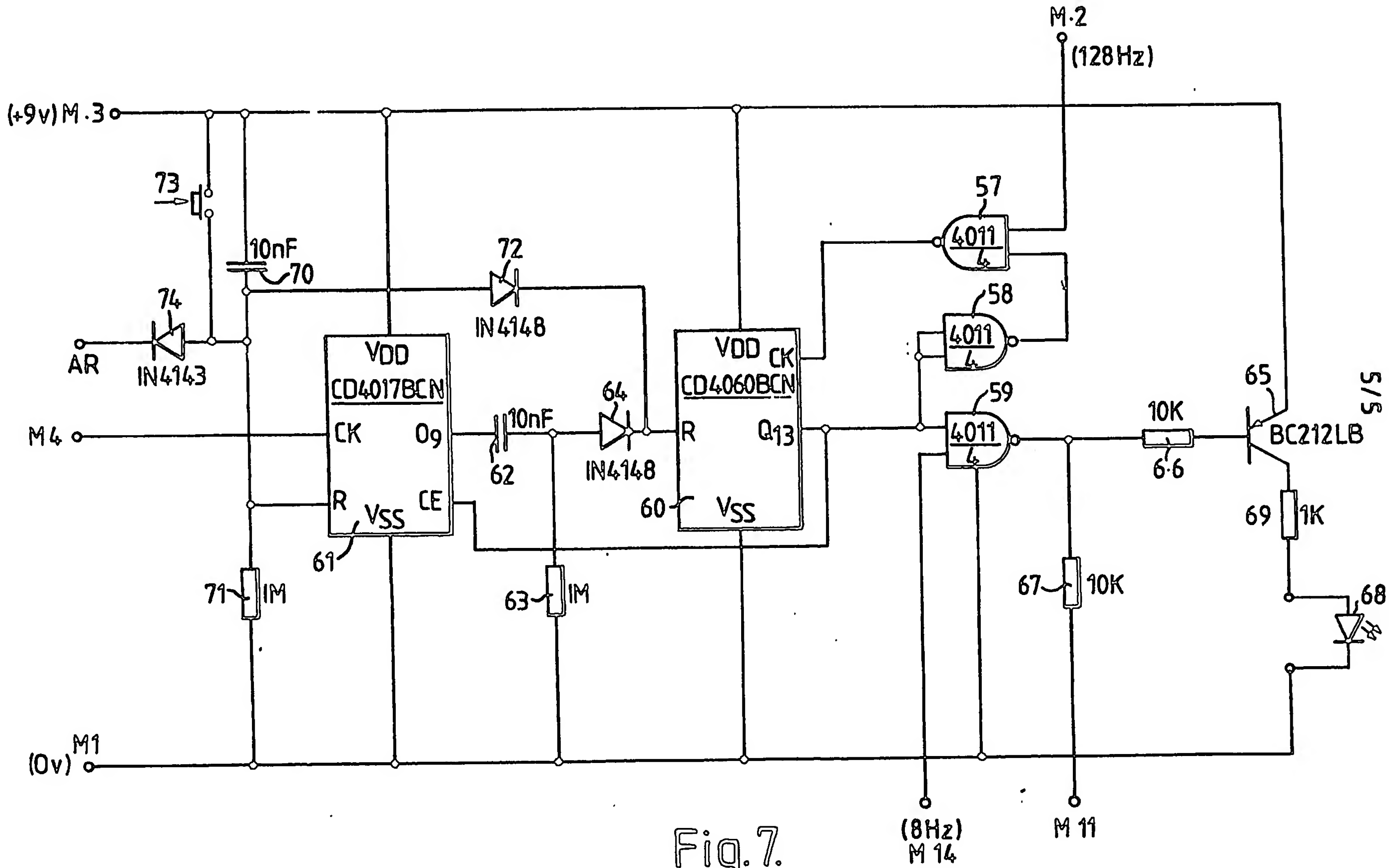
IC N°	IC TYPE	IC N°	IC TYPE
1	ICL 7621 DCPA	6	CD 4060 BCN
2	ICL 7621 DCPA	7	CD 4017 BCN
3	CD 4093 BCN	8	CD 4017 BCN
4	CD 4011 BCN	9	CD 4013 BCN
5	CD 4011 BCN	10	CD 40106 BCN

Fig.5.



IC N°	IC TYPE	IC N°	IC TYPE
1	ICL 7621 DCPA	6	CD 4060 BCN
2	ICL 7621 DCPA	7	CD 4024 BCN
3	CD 4093 BCN	8	CD 4013 BCN
4	CD 4011 BCN	9	CD 40106BCN
5	CD 4011 BCN		

Fig.6.


(+9v) M.3
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10nF
70
74
AR
IN4143
M4
(0v) M1
71
IM
VDD
CD4017BCN
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R
VSS
09
CE
61
72
IN4148
62
10nF
64
IN4148
63
IM
VDD
CK
CD4060BCN
R
Q13
VSS
60
M.2
(128Hz)
57
4011
58
4011
59
4011
(8Hz)
M 14
67
10K
M 11
10K
6.6
65
BC212LB
69
1K
68

Fig.7.

RESPIRATION SENSOR AND MONITOR

The present invention relates to a sensor and also to a monitor for detecting abdominal movements associated with breathing. Both find application in monitoring respiration primarily of babies and young children, but also of adults and, in particular, in detecting cessation of breathing.

Respiration sensing systems which either do or do not contact the body of the person under surveillance are known. Of these, those based on detecting changes in capacitance only detect forces in a single direction and are therefore limited in their sensitivity. Further, they measure motion of the body with respect to a fixed surface or reference and, therefore, do not permit the person under surveillance to be moved, thereby restricting the situations in which they may be used.

Pneumatic sensing systems which are attached to the body for monitoring movement directly are also known. However, such systems are not reliable since they pick up movements not only in the abdominal wall but also those of other origins.

An object of one aspect of the present invention is to provide a sensor for detecting abdominal movements associated with breathing which can be used in a wide variety of situations including, for example, in a movable cot or bed, in a car or when being carried.

An object of a further asp ct of the present

invention is to provide a respiration monitor capable of distinguishing those movements related to breathing from other body movements.

According to one aspect of the present invention there is provided a sensor for attachment to the abdominal wall of a person in order to detect abdominal movements associated with breathing, comprising: two flexible conductive layers separated by a flexible dielectric layer, and connecting means for connecting the two conductive layers to a monitoring circuit responsive to changes in capacitance, wherein flexure of said conductive layers caused by said abdominal movements produces changes in the capacitance between these layers.

In a preferred embodiment of the present invention, the sensor comprises three superimposed flexible conductive layers, each of the outermost layers being separated from the innermost layer by a flexible dielectric layer. In this case the connecting means connect all three conductive layers with a monitoring circuit responsive to changes in capacitance across the conductive layers. These connecting means preferably comprise co-axial cable, the two outermost conductive layers and the innermost conductive layer being connected to the screen and central conductor, respectively. This embodiment has the advantage that the output of the sensor is screened from external fields.

In one embodiment of the invention the or at least one of the insulating layers is resiliently compressible. In an alternative embodiment, a resiliently compressible

element is located between the or at least two of the conductive layers. In the case of a sensor having three conductive layers this element is preferably located between the innermost conductive layer and that outermost conductive layer intended to be located adjacent the body.

The present sensor is preferably sealed within an envelope consisting of an impervious material, such as, a plastics material. This envelope preferably also includes the connecting means.

According to the further aspect of the present invention, there is provided a respiration monitor for detecting cessation of breathing comprising a sensor for attachment to the abdominal wall of a person and which is responsive to movement in the abdominal wall to alter its impedance; circuit means adapted to detect those changes in the impedance of the sensor having frequency and amplitude characteristics appropriate to movements associated with breathing, and alarm means responsive to the absence of detection of breathing movements over a predetermined period to indicate cessation of breathing.

According to a preferred embodiment of the respiration monitor, abdominal wall movements produce changes in capacitance in the sensor which are detected by the circuit means. In one such embodiment, changes in capacitance of the sensor determine the output of a variable frequency oscillator whose output is converted to a voltage and fed to an amplifier whose frequency characteristic corresponds to the frequency range of abdominal wall

movements associated with breathing. In one embodiment, the output of the variable frequency oscillator is fed to a frequency to voltage converter, by means of a frequency modulated radio link enabling remote location of the remainder of the circuit and alarm means from the sensor.

In a preferred embodiment, a reset circuit is provided which permits return of the respiration monitor from an alarm to a monitoring condition only after a predetermined number of successive"normal" breaths have been detected. This reset circuit thereby reduces the possibility of an alarm condition being cancelled erroneously.

Preferably, the reset circuit also functions as a fail safe device during monitoring, activating the alarm condition in the event of a failure in the circuit means.

In a preferred embodiment, the respiration monitor also comprises a circuit for detecting breathing rate and producing an alarm signal should this rate fall below a predetermined level.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 illustrates, diagrammatically, a cross-sectional view of a sensor of an embodiment of the present invention;

Fig. 2 is a diagrammatic representation from above of the sensor shown in Figure 1;

Fig. 3 represents an embodiment of a respiration

monitor acc rding to the pr sent invention, in which the sensor of Figures 1 and 2 is mounted to the abdominal wall of a patient;

Fig. 4 is a block circuit diagram illustrating an embodiment of a respiration monitor according to the present invention;

Fig. 5 is a circuit diagram illustrative of an embodiment of a respiration monitor according to the present invention;

Fig. 6 is a circuit diagram illustrative of another preferred embodiment of a respiration monitor according to the present invention, and

Fig. 7 is a circuit diagram of a low breath rate alarm for incorporation in the circuit shown in Fig. 6.

The embodiment of the sensor 1 shown in Figures 1 and 2 comprises two superimposed flexible layers 2 and 3 comprising metallic film 2a, 3a having a dielectric layer 2b, 3b, respectively, on their facing surfaces. Between the layers 2 and 3 is a flexible conductive layer 4 comprising a metallic film which forms a capacitor with each of the other two layers, 2 and 3. A resiliently compressible element of, for example, foamed plastics material is provided between the central layer 4 and that outermost layer 3 intended to be located adjacent the abdominal wall of the patient.

As can be seen from Figure 2, the layers 2, 3, 4 and 5 are disc shaped, the compressible element 5 having a radius considerably smaller than that of the layers 2, 3 and

4 and being located centrally thereof.

The metallic films 2a, 3a of the outermost layers 2 and 3 are connected to the screen 6 of a coaxial cable 7, the innermost layer 4 being connected to the central conductor 8.

The entire sensor 1 including coaxial cable 7 is located within an impervious envelope 9 of, in this case, a plastics material.

Figure 3 shows the sensor 1 mounted to the abdominal wall 51 of a patient by means of, for example, adhesive tape 52, and connected to a monitoring and alarm circuit 10. As an alternative or in addition to the adhesive tape 52, a double sided adhesive layer can be located between the abdominal wall and the adjacent wall of the envelope 9 to mount the sensor to the abdominal wall.

Movement of the abdominal wall of the patient during breathing causes flexure of the layers 2, 3 and 4 of the sensor 1. This flexure causes changes in the relative positions of the conductive films 2a, 3a and 4 and hence the capacitance across them. This effect is enhanced by the provision of the compressible element 5 by permitting greater changes in the curvature of outermost layer 3 relative to innermost layer 4.

A preferred manner in which these changes in sensor capacitance are employed to detect breathing and its cessation will now be described with reference to Figure 4 which illustrates an embodiment of the respiration monitor.

As pr viously described, the sensor 1 is c nnected

by coaxial cable to the monitoring and alarm circuit 10 which in this case is preferably powered by a 9V battery providing a 5V stabilized supply S. The combined sensor and coaxial cable capacitance is incorporated into a variable frequency oscillator A whose output frequency is dependent upon this capacitance. It will be appreciated that the cable characteristics are important in this connection and a typical cable length is 1.4 m.

The output from the frequency oscillator A is then converted to voltage amplitude by a frequency to voltage converter B, and AC coupled to an amplifier C whose frequency characteristic corresponds to the frequency range of the abdominal wall movements to be detected.

An amplitude discriminator D supplies an output to a breath pulse generator E only when the amplitude signal received from the amplifier C exceeds a preset threshold. In the present embodiment, the circuit is designed to permit adjustment (at F) of the sensitivity of the amplitude discriminator D dependent on the application and form of the sensor 1. In a preferred embodiment, this sensitivity adjustment is preset during manufacture.

The breath pulse generator E converts the output of the amplitude discriminator D into appropriate pulses which are fed to a visual indicator G which flashes in response to each pulse. The output of the breath pulse generator E is also fed, optionally via an audible click control H, for example, a manually operable switch, to an audible indicator I which produces a click per pulse, that is, per breath

detected.

An oscillator J feeds a counter K and oscillator monitor M. The output of the counter K is delayed by a preselected period (e.g. 10, 15 or 20 seconds) determined by a selector N and fed to an alarm control O. In the absence of a breath pulse from generator E within the preselected period, the alarm control O produces a signal which activates a visual alarm P and the audible alarm at Q to alert medical staff or other supervisor to a respiratory problem.

After an alarm condition has been indicated, an alarm reset L may require one or more breathing signals to be detected before one or both of the alarm indicators Q and P are reset. In a preferred embodiment, a succession of two or more breaths have to be detected before the audible alarm Q is silenced and the system is returned to normal monitoring. In one such case, the alarm reset L detects the presence of the preset number of successive breath pulses from generator E to produce a signal which causes the alarm control O to de-activate the audible alarm Q; the visual alarm P remaining activated until reset by a manually operable switch.

There are two further situations in which the alarm control is caused to activate the alarm indicators Q,P. In the case of a failure in the operation of the oscillator J, the oscillator monitor M produces an output signal which causes the alarm control O to produce both and a visual alarm at Q and an audible alarm at P.

Should the battery power fall below a predetermined acceptable level, a battery detector T sends a signal to the alarm control O to produce audible and visual alarms at Q and P and also to a dedicated low battery power visual indicator U.

Figure 5 illustrates the monitoring and alarm circuit of an embodiment of the respiration monitor. The variable frequency oscillator A is shown as an inverter 11 and resistor 12. The output of this oscillator A passes via an inverter 13 to a frequency to voltage converter B comprising inverters 14, 15, diode 16, npn transistor 17 and capacitor 18. The output of the voltage converter B is coupled via a capacitor 19 and resistances 20, 21 to the inputs of an amplifier 22 whose frequency characteristic matches the frequency range of the abdominal motion being detected. The output of this amplifier 22 is fed to the negative terminal of an amplifier 23 whose positive terminal is connected during manufacture to a variable potentiometer whose setting controls the sensitivity required of that particular monitor. This amplifier 23 constitutes the amplitude discriminator D shown in Figure 4.

The output of the amplifier 23 is fed via inverters 24, 26 and capacitor 25 constituting the breath pulse generator E of Fig. 4, to a light emitting diode (LED) at 49 which gives a flash per pulse received to indicate breathing. This output is also fed via a manually operable switch 27 to an audible devic at 28 which gives a click per pulse, that is, per breath detected.

In addition, the output of inverter 26 of th breath pulse generator E is fed to one input of a NAND gate 29 and to a counter 30. Depending on the position selected for a reset switch 31, the counter 30 feeds the other input of the NAND gate 29 via one of two pins. During normal breathing, NAND gate 29 is non-conductive and a subsequent NAND gate 32 conductive.

Supplying one of the inputs of the NAND gate 29 via counter 30 ensures that an alarm condition (as will be described below) is initiated in the event that, due to a malfunction, the breath pulses do not have a predetermined frequency.

NAND gate 32 is connected to counter 35 of an oscillator 33 comprising a crystal 34. This oscillator 33 has two outputs, one of 2 Hertz supplying counters 36 and 37 and the other of 8 Hertz supplying counter 30. Gate 32 is also connected to counters 36 and 37. Counter 37 has three selectable outputs giving, respectively, a 10, 15 and 20 seconds delay. The selected output feeds a further NAND gate 38 whose output is fed to a latch 39 which operates an alarm LED at 40 via NAND gate 50. The output of NAND gate 38 also feeds another NAND gate 41 which controls the audible alarm device at 28.

In the absence of a breath pulse, NAND gate 29 conducts causing NAND gate 32 to cease conduction. If NAND gate 32 remains non-conductive beyond the period determined by the pre-selected output of counter 37, NAND gate 38 becomes non-conductive which causes the latch 39 to operate

the alarm LED at 40 and NAND gates 41, 47 to operate the audible alarm at 28.

In accordance with the position set for reset switch 31, the alarm condition will be cancelled following the receipt of either one breath pulse or two successive breath pulses from breath pulse generator E. Once the counter 30 has counted this preset number of pulses, its output causes NAND gate 29 to become non-conductive and hence gate 32 to conduct, thereby returning the circuit to the normal monitoring condition and silencing the audible alarm at 28. However, the alarm LED at 40, whose operation is controlled by the latch 39, will remain activated until it is manually reset by a switch. In this embodiment, this switch is also on/off switch SW1 for the battery supply.

Counter 30 also operates as the oscillator monitor M of Figure 4. In the absence of an output from the oscillator 33, the output from the counter 30 becomes zero and the NAND gate 29 becomes conductive initiating an alarm condition as already described.

The low battery detector T is constituted by an amplifier 42 whose negative input is fed by a 1.26 volt zener diode 43 while its positive input is fed by a voltage proportional to the battery output. When the battery voltage falls below a predetermined level, the output of amplifier 42 changes level. This causes NAND gates 44 and 45 to activate a LED at 46 and also the audible alarm at 28 via NAND gates 41 and 47.

As will be seen from Fig. 5 connector means ar

provided at 48 for connection of auxiliary equipment for activation when an alarm condition is indicated via NAND gate 41.

Figure 6 illustrates the monitoring and alarm circuit of a further embodiment of the repiration monitor. It will be seen that this circuit is very similar to that shown in Figure 5 the principal differences being found in the construction of the counter K and delay select N circuitry.

In this embodiment a NAND gate 52, counter 53 and two schmitt triggers 54 and 55 replace the counters 36 and 37 and NAND gate 38 shown in Figure 5. Counter 53 is fed by the outputs of NAND gates 32 and 52 and has two pairs of outputs, each feeding the inputs of a respective one of the schmitt triggers 54, 55 which thereby provide two manually selectable outputs giving, respectively, a 10 and a 20 second delay. The output of the selected output is fed back to one input of NAND gate 52, the other input of which is connected to the 2 Hertz output of counter 35 of the oscillator 33..

In the absence of a breadth pulse, NAND gate 32 goes low. If it remains low beyond the pre-selected 10 or 20 second period, the output of the respective schmitt trigger 54,55 goes low causing the latch 39 to operate the alarm LED at 40 as described in relation to the embodiment shown in Figure 5.

As the output of the selected schmitt trigger is also supplied to one input of the NAND gate 52, once this

goes low establishing an alarm state, the output of the gat 52 in turn inhibits further counting in the counter 53.

In this embodiment, the alarm LED at 40 is reset by a dedicated manual switch at 56 rather than the ON/OFF switch SW1 for the battery supply.

Figure 7 illustrates a circuit for a low breath rate alarm. This is an additional alarm facility intended for connection in the circuit shown in Figure 6, those terminals marked M1, M2, M3, M4, M11, M14 and AR being connected to correspondingly marked terminals in Figure 6. It consists of a breaths counter circuit to which the output of the breath pulse generator E is supplied and a 64 second timing circuit having two outputs, one connected to a visual alarm and the other to the audible alarm Q. The specific construction and operation of the circuit shown in Figure 7 is described below.

A 128 Hz input from oscillator 33 (Figure 6) on M2 is fed via one input of a NAND gate 57 to the clock input of a counter 60 when the other input to the gate 57 is low. An output Q_{13} of counter 60 is able to change state once 64 seconds have been counted.

The breadth pulse output from generator E is suppled to the clock input of another counter 61 via terminal M4. A count of 10 breath pulses enables a change in state of an output 0_8 of the counter 61, which is fed to the reset input R of counter 60 via capacitor 62, resistor 63 and diode 64. Provided this reset occurs within 64 seconds, the output Q_{13} of counter 60 does not change state. If, however, 10

breath pulses are not detected at the clock input to counter 61 and the counter 60 reset within 64 seconds, output Q_{13} changes state by going low.

One input of NAND gate 59 is fed by the output Q_{13} of counter 60 and the other is connected to the 8 Hz output of the oscillator 33. The output of the NAND gate 59 is connected to the base of pnp transistor 65, via a resistor 66 and to the drive of the audible alarm Q at terminal M11 via resistor 67. The collector of pnp transistor 65 is connected to a light emitting diode 68 via a resistor 69.

Clearly when the output Q_{13} goes low, the output of NAND gate 59 goes high rendering the transistor 65 conductive and actuating LED 68. Further, the audible alarm Q at 28 is activated via terminal M11.

Output Q_{13} is also fed to both inputs of NAND gate 58 whose output feeds one input of NAND gate 57. When the output of Q_{13} is high, the output of gate 58 is low rendering gate 57 conductive. However, when a low breathing rate is detected and output Q_{13} goes low, the output of gate 58 goes high causing the output of gate 57 to go low thereby preventing resetting of output Q_{13} after a count of 64 seconds.

The state of output Q_{13} is also fed back to counter 61 to inhibit further counting in counter 61 when output Q_{13} indicates an alarm condition by going low.

It will be appreciated that the output of NAND gate 59 will also become high should the 8 Hz output of the oscillator 33 fail causing an alarm condition to be

indicated at LED 68 and also by the audible alarm Q at 28.

The reset R input of converter 61 is connected to the 9 and 0 volt rails via a capacitor 70 and resistor 71 and that of counter 60 additionally via diode 72, to ensure reset of the counters 60,61 when the circuit is turned on at ON/OFF switch SW1 (see Figure 6).

A reset button 73 connected across capacitor 70 and to terminal AR via a diode 74, permits resetting of the low breath rate alarm circuit of Figure 7 following indication of an alarm condition.

It will be seen that the provision of diode 51 after NAND gate 32 in the circuit shown in Figure 6, is solely to permit connection of the low breath rate alarm circuit.

In the embodiment illustrated in Figures 5 and 6, the variable frequency oscillator A is provided in a single unit with the remainder of the circuitry making up the monitoring and alarm circuit 10. In an alternative embodiment, this variable frequency oscillator A is provided separately from the remainder of the circuitry, its output being fed to the voltage converted B by means of a frequency modulated radio link. This technique of FM radio link between such an oscillator and voltager converted is a standard technique well known in the art and permits the remainder of the monitoring and alarm circuitry to be located remote from the sensor and hence the patient being monitored (for example) in another room.

CLAIMS

1. A sensor for attachment to the abdominal wall of a person in order to detect abdominal movements associated with breathing, comprising: two flexible conductive layers separated by a flexible dielectric layer, and connecting means for connecting the two conductive layers to a monitoring circuit responsive to changes in capacitance, wherein flexure of said conductive layers caused by said abdominal movements produces changes in the capacitance between these layers.

2. A sensor as claimed in claim 1 which comprises three superimposed flexible conductive layers, each of the outermost layers being separated from the innermost layer by a flexible dielectric layer, and wherein the connecting means connect all three conductive layers with a monitoring circuit reponsive to changes in capacitance across the conductive layers.

3. A sensor as claimed in claim 2 wherein the connecting means comprise co-axial cable, and two outermost conductive layers and the innermost conductive layer being connected to the screen and central conductor, respectively.

4. A sensor as claimed in any preceding claim wherein the or at least one of the insulating layers is resiliently compressible.

5. A sensor as claimed in any of claim 1 to 3 wherein a resiliently compressible element is located between the or at least two of the conductive layers.

6. A sensor as claimed in claim 5 having three conductive layers wherein the resiliently compressible element is located between the innermost conductive layer and that outermost conductive layer intended for location adjacent the body.

7. A sensor as claimed in any preceding claim further comprising an envelope of an impervious material enclosing the conductive layers.

8. A sensor as claimed in claim 7 wherein the connecting means are also within said envelope.

9. A sensor as claimed in claim 7 or 8, wherein said envelope is of plastics material.

10. A sensor for attachment to the abdominal wall of a person in order to detect abdominal movements associated with breathing substantially as herein described with reference to Figures 1 and 2 with or without reference to any of Figures 3 to 7 of the accompanying drawings.

11. A respiration monitor comprising a sensor as claimed

in any preceding claim.

12. A respiration monitor for detecting cessation of breathing comprising circuit means adapted to detect changes in the impedance of a the sensor responsive to movement in the abdominal wall of a person by altering its impedance; which circuit means have frequency and amplitude characteristics appropriate to movements associated with breathing, and alarm means responsive to the absence of detection of breathing movements over a predetermined period to indicate cessation of breathing.

13. A respiration monitor as claimed in claim 12 further comprising the sensor for attachment to the abdominal wall of a person.

14. A respiration monitor as claimed in claim 12 or 13 wherein abdominal wall movements produce changes in the capacitance of the sensor which are detected by the circuit means.

15. A respiration monitor as claimed in any of claims 12 to 14 wherein the sensor is as claimed in any one of claims 1 to 10.

16. A respiration monitor as claimed in claim 14 or 15 wherein the circuit means comprise a variable frequency oscillator responsiv to changes in capacitance to produce

an output.

17. A respiration monitor as claimed in claim 16 wherein, the circuit means further comprise frequency to voltage conversion means for converting the output of the variable frequency oscillator to a voltage, and an amplifier whose frequency characteristic corresponds to the frequency range of abdominal wall movements associated with breathing and to which said voltage is fed.

18. A respiration monitor as claimed in claim 17 wherein the output of the variable frequency oscillator is fed to the frequency to voltage conversion means by means of a frequency modulated radio link.

19. A respiration monitor as claimed in any of claims 12 to 16 wherein said circuit means comprise an amplifier whose frequency characteristic corresponds to the frequency range of abdominal wall movements associated with breathing.

20. A respiration monitor as claimed in any of claims 12 to 19 wherein the predetermined period over which the absence of detection of breathing movements results in the alarm means indicating cessation of breathing, is selectable from a plurality of predetermined periods.

21. A respiration monitor as claimed in any of claims 12 to 20 wherein a reset circuit is provided which permits

return of the respiration monitor from an alarm to a monitoring condition only after a predetermined number of successive "normal" breaths have been detected.

22. A respiration monitor as claimed in claim 21, wherein the predetermined number is two.

23. A respiration monitor as claimed in claim 21 or 22 wherein the reset circuit also functions as a fail safe device during monitoring, activating the alarm condition in the event of a failure in the circuit means.

24. A respiration monitor as claimed in any of claims 12 to 23 further comprising a circuit for detecting breathing rate and producing an alarm signal should the rate of breathing fall below a predetermined level.

25. A respiration monitor for detecting cessation of breathing substantially as herein described with reference to Figure 4 with or without reference to any of Figures 1 to 3 and 5 to 7 of the accompanying drawings.

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